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EXAMINER	
STOCK JR, GORDON J	

ART UNIT	PAPER NUMBER
2877	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/841,044	HAGIWARA ET AL.	
	Examiner	Art Unit	
	Gordon J Stock	2877	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *3/8/04;3/30/04*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-24,44-51 and 53-63* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-24, 44-51, 53-63* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *08 March 2004* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

2. **Claims 1-23, 46-51, 53-63** are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

3. The terms "in the vicinity of an image plane" and "in a vicinity of a focal position" in **claims 1, 8, 46, and 51** are relative terms which renders the claim indefinite. The term "in the vicinity"/"in a vicinity" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. The term "vicinity" renders the positions of the pattern forming member and the aerial image formation indefinite. **Claims 2-7, 9-23, 47-50, 53-63** are rejected for being dependent upon a rejected base claim.

4. As for **claims 3, 4, 53**, the claims are indefinite, for it is unclear how the width may both be "equal to and under" the wavelength divided by numerical aperture.

Claim Rejections - 35 USC § 102

5. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

6. **Claims 1-4, and 7** are rejected under 35 U.S.C. 102(b) as being anticipated by **Sogard (5,631,731).**

As for **claims 1-4, and 7**, Sogard in a method and apparatus for aerial image analyzer teaches the following: illuminating a mark, a test pattern, with an illumination light and forming an aerial image of said mark on an image plane via said projection optical system; arranging a slit-shaped aperture pattern in a first direction within a two-dimensional plane perpendicular to an optical axis of said projection optical system near the image plane of the optical system, the width of said slit-shaped aperture pattern being set in consideration of both the wavelength and the numerical aperture and is under wavelength divided by numerical aperture and multiplied by .8, 50nm, 100nm, and 200nm; scanning pattern forming member in said second direction; photoelectrically converting said illumination light and obtaining a photoelectric conversion signal corresponding to intensity; whereas, a spatial frequency distribution is obtained via Fourier transforming signal; converting said distribution by dividing said distribution with a frequency of said aperture pattern that is already known; and inverse Fourier transforming spectral distribution (Figs. 1a, 1b, 2, 3a, 3b; col. 4, lines 30-45; col. 6, lines 45-65; col. 5, lines 20-25; col. 9, lines 60-67; col. 10, lines 1-50)

Claim Rejections - 35 USC § 103

7. The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

8. **Claims 5, 6, 24, 44-51, 53, 54, 56-58, 62, 63** are rejected under 35 U.S.C. 103(a) as being unpatentable over **Sogard (5,631,731).**

As for **claims 5, 6,** Sogard discloses everything as above (see **claim 1**). He is silent concerning the width of the slit pattern having a half a pitch divided by an odd number or width is set as one half of the wavelength divided by numerical aperture. However, he does state that the widths are related to numerical aperture and wavelength and are made to be of adequate resolution to produce the aerial image (col. 9, line 55-67; col. 10, lines 1-50). And states that the maximum spatial frequency possible is the numerical aperture divided wavelength (col. 6, liens 35-50). And the slits appear to be a multiple of the wavelength divided by numerical aperture for the slits are 50, 100, 150, 200 nm or range of slit widths (col. 5, lines 20-25; table 1; Fig. 12) and the numerical aperture of the system is .6 and the wavelength used is 248 nm with a coherence factor of .5 (col. 9, lines 55-65). These widths are optimal values. It would have been obvious to one having ordinary skill in the art at the time of the invention was made to have the widths be a minimum pitch multiplied by an odd number or be half the wavelength divided by numerical aperture multiplied by an odd number, since it has been held that discovering an optimum value of a result effective variable involves only routine skill in the art. In re Boesch, 617 F.2d 272, 205 USPQ 215 (CCPA 1980)

As for **claim 24**, Sogard teaches illuminating a first mark at a first detection point within a field of optical projection system to form an aerial image of said first mark, and measuring light intensity distribution by scanning slit-like pattern with respect to said aerial image of said first mark and converting photoelectrically light; illuminating a second mark at a second point different from the first; whereas, Fig. 2 demonstrates a multiplicity of patterns and a multiplicity of positions to be investigated (Figs. 1a, 1b, 2, 3a, 3b; col. 9, lines 60-67; col. 10, lines 1-50). As for telecentricity, Sogard is silent, but he discloses that basic lens aberrations

may be determined (col. 3, lines 65-67; col. 4, lines 1-2). Therefore, it would be obvious to one skilled in the art that telecentricity would be calculated for the procedure is used to determine basic lens aberrations such as telecentricity.

As for **claims 44-45**, Sogard discloses everything as above (see **claim 24**). In addition, he teaches two marks that are the same (Fig. 2). And the dimensions of the slit pattern are set in consideration of numerical aperture and wavelength (col. 9, lines 55-67; col. 10, lines 1-50).

As for **claim 46**, Sogard discloses the following: an illumination unit (Fig. 1a: 12); a pattern forming member that is set in regards to numerical aperture and wavelength (col. 9, lines 55-67; col. 10, lines 1-50; Fig. 1a: 13; Fig. 3a); a photoelectric conversion element (Figs. 3a and 3b: 45, 46, 48) The system scans the pattern (Figs. 3a and 3b). As for processing unit, he is silent, but Sogard suggests that there is a processing unit, for data is accumulated and displayed (Figs. 5, 7-16). Processing units are well known in the art for processing data. It would be obvious to one skilled in the art that the system had a processing unit, for there is scanning and the data is processed to provide graphical relationships between variables.

As for **claim 47**, Sogard discloses everything as above (see **claim 46**). As for a calculation unit, he is silent. However, he teaches that aberrations may be determined (col. 3, lines 65-67). Therefore, it would be obvious to one skilled in the art at the time the invention was made to have the system comprise a calculation unit in order to calculate aberrations that may be present in the exposure system.

As for **claim 48,** Sogard discloses everything as above (see **claim 46**). In addition, he discloses a substrate stage and the pattern-forming member is integral with stage (Fig. 1a, 18, 13). And the aerial image analyzer is part of a projection photolithography system (Fig. 1a: 10).

As for **claim 49**, Sogard discloses everything as above (see **claim 46**). As for a control unit, he is silent. However, he teaches that aberrations may be determined (col. 3, lines 65-67). Therefore, it would be obvious to one skilled in the art at the time the invention was made to have the system comprise a control unit in order to calculate aberrations that may be present in the exposure system.

As for **claim 50**, Sogard discloses everything as above (see **claim 46**). As for a mark detection system and control unit, he is silent. Mark detection systems are well known in the art for detecting positions of marks for positional and alignment adjustment in photolithography systems. Therefore, it would be obvious to one skilled in the art to have the exposure apparatus comprise a mark detection system in order to provide positional and alignment detection in the exposure system. As for a control unit, he is silent. However, he teaches that aberrations may be determined (col. 3, lines 65-67) and there is a positional relationship between the marks and the slit pattern, for the test patterns projected have a two dimensional configuration and are at a plurality for projecting in several locations (col. 3, lines 60-65; Fig. 2: 9 sets of patterns comprising at least 8 different patterns). Therefore, it would be obvious to one skilled in the art at the time the invention was made that the system comprises a control unit that determines positional relationships between pattern and the marks, for the image quality of the system may be well characterized over the entire image field and separate determination of a number of lens aberrations may also be determined.

As for **claims 51, 54, 56**, Sogard discloses the following: a self-measurement master, test pattern mask (Fig. 2); an aerial image measurement unit comprising: a pattern forming member; a photoelectric conversion element with driving unit (Figs. 3a and 3b); with a source of

illumination for illuminating said pattern to form aerial image and are scanned (Fig. 1a: 12, Figs. 3a). As for a self-measurement master mounting stage, Sogard is silent. However, he teaches that the reticle is replaced by the test pattern (col. 3, lines 45-50). Reticle stages are well known in the art for positioning the reticle for exposure. Therefore, it would be obvious to one skilled in the art that the system comprised a reticle stage in order to position the reticle above the wafer for illumination.

As for **claim 53**, Sogard discloses everything as above (see **claim 51**). In addition, there is a slit-shaped aperture pattern (Figs. 3a) that the width of said slit-shaped aperture pattern being set in consideration of both the wavelength and the numerical aperture and is under wavelength divided by numerical aperture and multiplied by .8, 50nm, 100nm, and 200nm (col. 9, lines 55-67; col. 10, lines 1-50).

As for **claims 57 and 58**, Sogard discloses everything as above (see **claim 51**). In addition, Sogard discloses line and space marks that are isolated from one another (Fig. 2). These marks are for distortion measurements (col. 3, lines 60-67; col. 4, lines 1-6).

As for **claims 62 and 63**, Sogard discloses everything as above (see **claims 48 and 51**); whereas, exposure is performed by lithography system (Fig. 1a: 10; Fig. 18).

9. **Claims 8, 13-20, 22, 23, 59, 60, and 61** rejected under 35 U.S.C. 103(a) as being unpatentable over **Sogard (5,631,731)** in view of **White (6,379,868)**—previously cited.

As for **claims 8 and 23**, Sogard in a method and apparatus for aerial image analyzer teaches the following: illuminating a mark, a test pattern, with an illumination light and forming an aerial image of said mark on an image plane via said projection optical system; arranging a slit-shaped aperture pattern in a first direction within a two-dimensional plane perpendicular to

an optical axis of said projection optical system near the image plane of the optical system, the width of said slit-shaped aperture pattern being set in consideration of both the wavelength and the numerical aperture; scanning said pattern forming member; photoelectrically converting said illumination light and obtaining optical properties such as aberrations based on signal (Figs. 1a, 1b, 2, 3a, 3b; col. 4, lines 30-45; col. 6, lines 45-65; col. 5, lines 20-25; col. 9, lines 60-67; col. 10, lines 1-50). As for the slit having dimensions being set in consideration of resolution, it is suggested (col. 10, lines 40-45). In addition, White in a lithographic process teaches that the ability of a feature to be resolved depends on the numerical aperture and wavelength (col. 5, lines 55-60). Therefore, it would be obvious that the silt dimensions are set in consideration of the resolution, for the slit's dimensions are considered in relation to numerical aperture and wavelength which define resolution.

As for **claim 13**, Sogard in view of White discloses everything as above (see **claim 8**). In addition, a plurality of positions are used to produce aerial images from the plurality of patterns on the test pattern (Fig. 2) and to make certain that the whole image field is characterized suggesting that determination of the aberrations are position and light intensity dependent; A distortion may be determined (col. 3, lines 60-65; col. 4, lines 1-5).

As for **claims 14-20, and 22** Sogard in view of White discloses everything as above (see **claim 13**). In addition, Sogard shows that the widths of said rectangular marks are wider than widths of slit with line and space patterns in several directions (Figs. 2 and 3a); phase detection is used (Fig. 13; col. 6, lines 25-35); and Figs. 3a-3b show that the intersection of the aerial image with a slice level, an individual slit, is used in the determinations. In addition, said mark is a line and space pattern having periodicity in several directions with two different width marks

in the same direction with symmetry (Fig. 2) and coma may be determined (col. 4, lines 1-2). As for an abnormal line width value or asymmetry being used to determine coma, Sogard is silent. However, Figs. 3a-3b are aerial images based on aberration free lenses that show symmetry. It would be obvious to one skilled in the art that the coma would be based on an abnormal line width value or an asymmetry, for a coma free system would have a symmetric normal line width value.

As for **claims 59-61**, Sogard in view of White discloses everything as above (see claim 8). In addition, Sogard states that optical properties are measured and the projection optical system is adjusted based on image field characterization, for exposure conditions are optimized (col. 3, lines 60-67; col. 4, lines 1-6). Fig. 18a demonstrates transferring said pattern onto a substrate. As for transferal after adjustment, exposure would be performed after optimization (col. 4, lines 1-4).

Allowable Subject Matter

10. **Claims 9-12, 21, 55** would be allowable if rewritten to overcome the rejection(s) under 35 U.S.C. 112, second paragraph, set forth in this Office action and to include all of the limitations of the base claim and any intervening claims.

As to **claim 9**, the prior art of record, taken alone or in combination, fails to disclose or render obvious in an optical properties measurement method "said mark consists of a line and space mark" and the particular predetermined evaluation amount, in combination with the rest of the limitations of **claims 9-12.**

As to **claim 21**, the prior art of record, taken alone or in combination, fails to disclose or render obvious in an optical properties measurement method the particular calculation result

being based on a phase difference between a first and second frequency component, in combination with the rest of the limitations of **claim 21.**

As to **claim 55**, the prior art of record, taken alone or in combination, fails to disclose or render obvious in an exposure apparatus the particular control unit, in combination with the rest of the limitations of **claim 55.**

Response to Arguments

11. Applicant's arguments with respect to the claims have been considered but are moot in view of the new ground(s) of rejection.

Fax/Telephone Numbers

If the applicant wishes to send a fax dealing with either a proposed amendment or a discussion with a phone interview, then the fax should:

1) Contain either a statement "DRAFT" or "PROPOSED AMENDMENT" on the fax cover sheet; and

2) Should be unsigned by the attorney or agent.

This will ensure that it will not be entered into the case and will be forwarded to the examiner as quickly as possible.

Papers related to the application may be submitted to Group 2800 by Fax transmission. Papers should be faxed to Group 2800 via the PTO Fax machine located in Crystal Plaza 4. The form of such papers must conform to the notice published in the Official Gazette, 1096 OG 30 (November 15, 1989). The CP4 Fax Machine number is: **(703) 872-9306**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Gordon J. Stock whose telephone number is (571) 272-2431. The examiner can normally be reached on Monday-Friday, 10:00 a.m. - 6:30 p.m.

gs
July 20, 2004

Zandra V. Smith
Primary Examiner